Source: Federal Institute for Research on Building, Urban Affairs and Regional Planning at the Federal Office for Building and Regional Planning

Guide to heavy rain - property protection and structural precautions

The return period T (annuality) describes the average frequency of occurrence of an event (once every T years), while the probability of occurrence in a year is expressed as 1/T. The rainfall duration D indicates the duration of the precipitation event. The precipitation height indicates how high (liquid) precipitation would cover a horizontal ground surface within the rainfall duration D if nothing could run off, evaporate or seep away from this surface (DWD Wetterlexikon).

Schmitt et al. (2018) developed a standardised, location-based method to describe heavy rainfall using a heavy rainfall index (SRI). With the help of the index, the events are divided into 'heavy rain' (SRI 1-2), 'intense heavy rain' (SRI 3-5), 'exceptional heavy rain' (SRI 6-7) and 'extreme heavy rain' (SRI 8-12) and are classified with different colours from SRI 1 to 12 (see Figure 1). In the case of SRI 1-2, these are already heavy rainfall events that are likely to cause damage.

Heavy rainfall index (SRI)

The heavy rainfall index (twelve levels) represents a generally understandable approach in risk communication to convey the character of heavy rainfall.

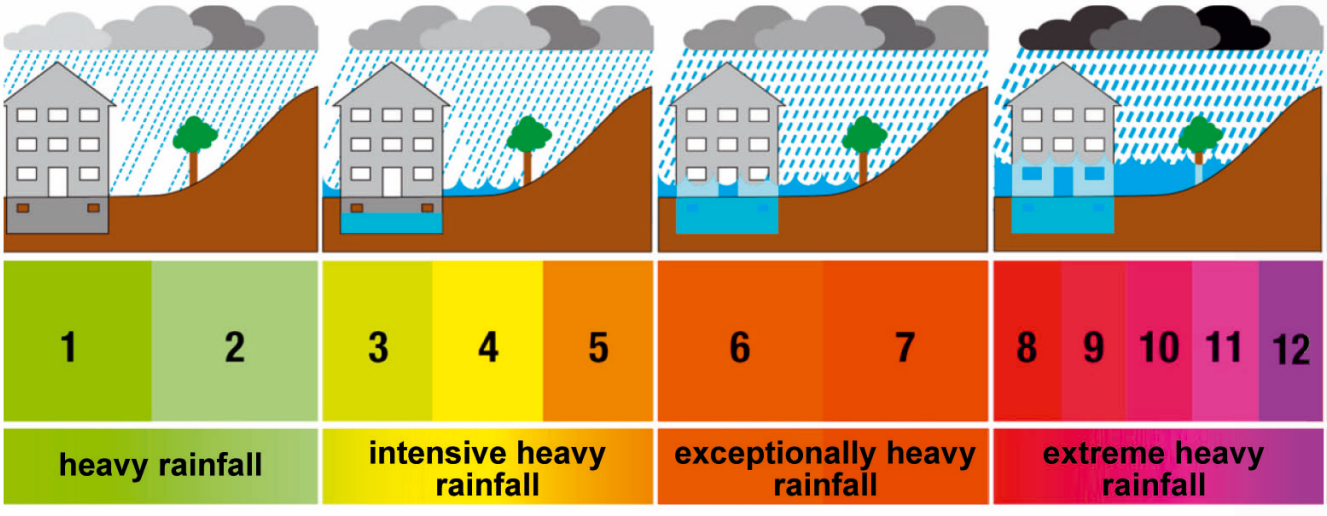

Figure 1
Evaluation categories of the location-related heavy rainfall index (Schmitt et al. 2018)

RESPONSIBILITY

According to DWA-M 119 (2016), responsible flood prevention is a joint task of the municipal stakeholders involved (in particular the drainage company, civil engineering office, green space office, road construction authorities, urban planning office) and the property owners.

Depending on the severity of the event, a distinction is made in flood prevention between three impact areas, each of which entails different responsibilities (see Figure 2). Within the limits of the measured rainfall, public drainage systems (municipal responsibility and measures for rainwater management and backwater protection of property drainage in accordance with DIN 1986-100) are decisive, while in the case of rare events, temporary water retention on traffic and open spaces (and damage-free drainage in the street area, municipal responsibility) is necessary.

Targeted property protection in private and public areas is essential in order to limit damage even in the event of exceptional heavy rainfall. The personal responsibility of property owners is crucial here.

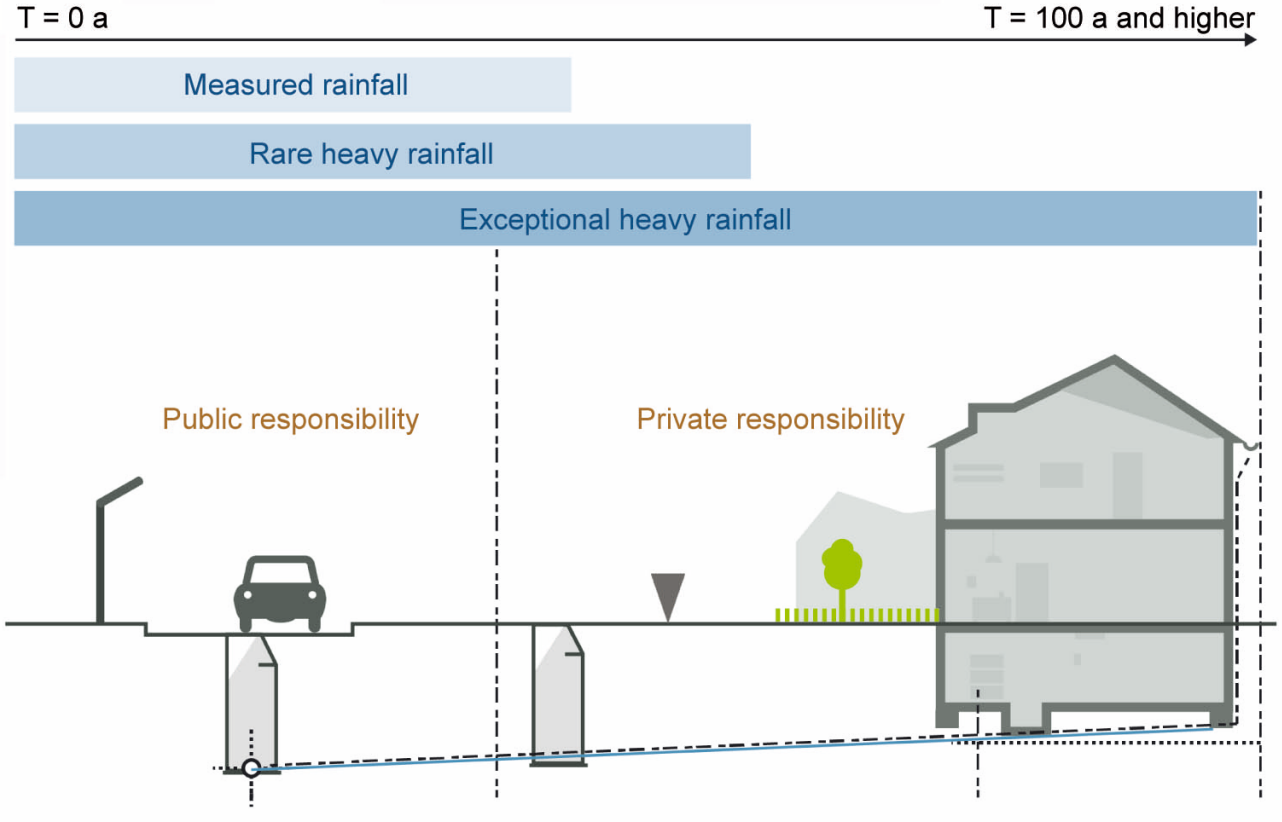

Figure 2
Flood protection precautions according to BBSR (2018) and DWA (2013) (Reinhard Beck engineering office)

The responsibilities, competences and influences of the various systems therefore depend on the intensity of the rainfall.

If the heavy rain index is taken into account, this can be summarised as follows:

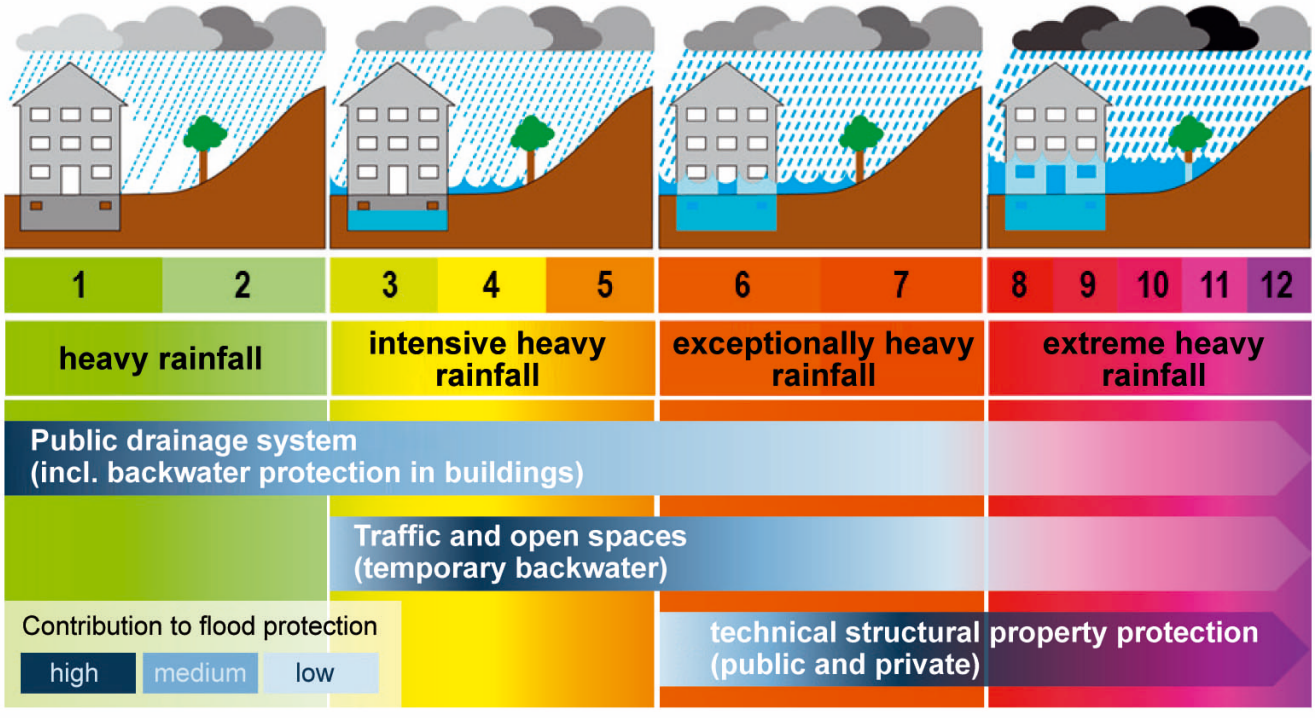

Figure 3
Evaluation categories of the location-related heavy rainfall index (Schmitt et al. 2018)

EXCURSUS

In Germany, the European standard DIN EN 752 'Drainage systems outside buildings - Sewer management' (DIN EN 752, 2017) forms the assessment basis for drainage systems outside buildings.

This standard contains assessment criteria for the verification of drainage systems and for sewer-indexed flooding. Furthermore, the DWA worksheet DWA-A 118 'Hydraulic design and verification of drainage systems' contains specifications (DWA-A 118, 2006).

The assessment criteria are specified in the form of the frequency of occurrence of precipitation (once in 'n' years). A distinction is made between the following criteria:

- Measured rainfall frequency: once in 1 to once in 10 years (DIN EN 752, 2017),
- Flood frequency: once in 2 to once in 10 years (DWA-A 118, 2006)
- Flooding frequency: once in 1 to once in 50 years (DIN EN 752, 2017)

EFFECTS OF HEAVY RAIN ON OBJECTS

During heavy rainfall, especially with blocked gutters and downpipes, the water shoots over the gutters, runs down the house walls and thus reaches sensitive areas and building openings (regular maintenance is important!)

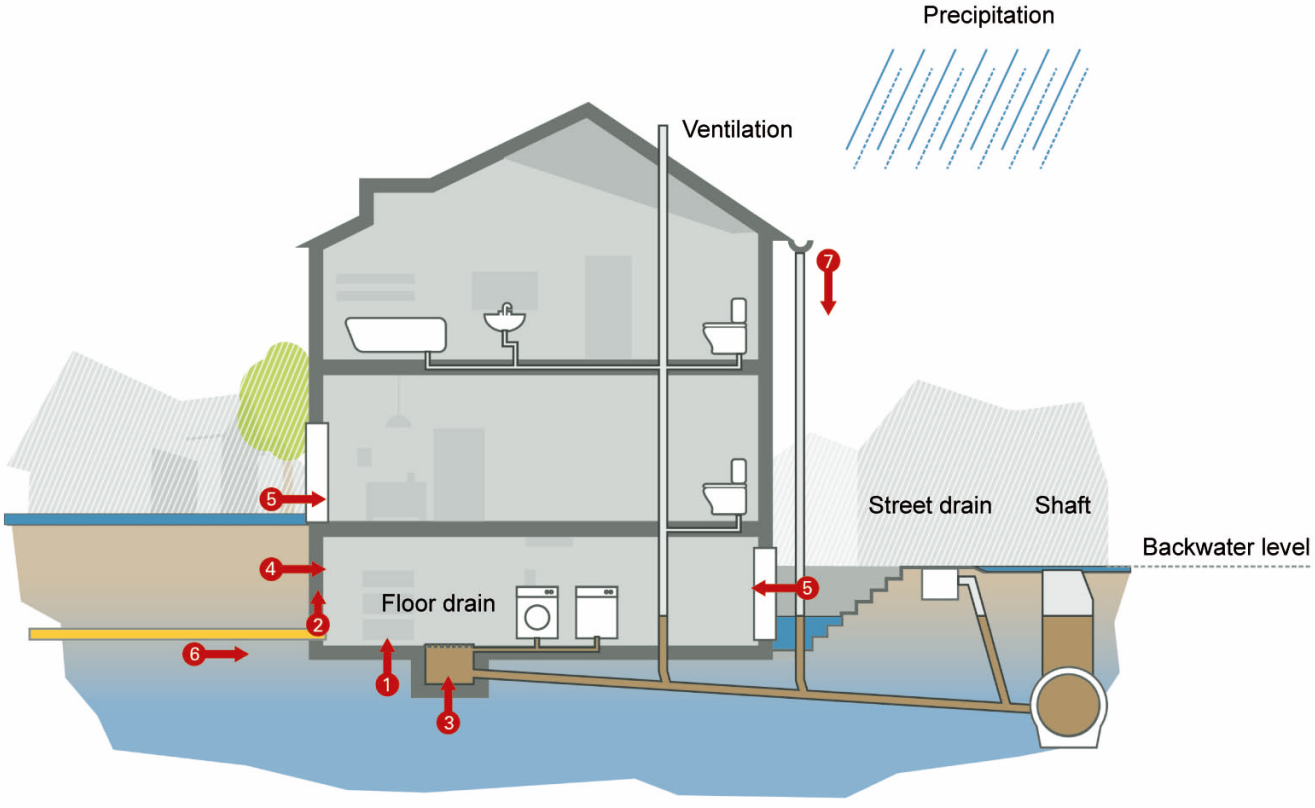

Figure 4
Water ingress possibilities due to heavy rainfall (Reinhard Beck engineering office)

PROTECTIVE MEASURES

BUILDING PROTECTION

The greatest damage is caused by heavy rain when the water enters the building (for information on the damage that water can cause outside the building, depending on the building materials selected). If buildings are not sufficiently protected, there are many ways in which water can enter the building. Measures to prevent this are presented below.

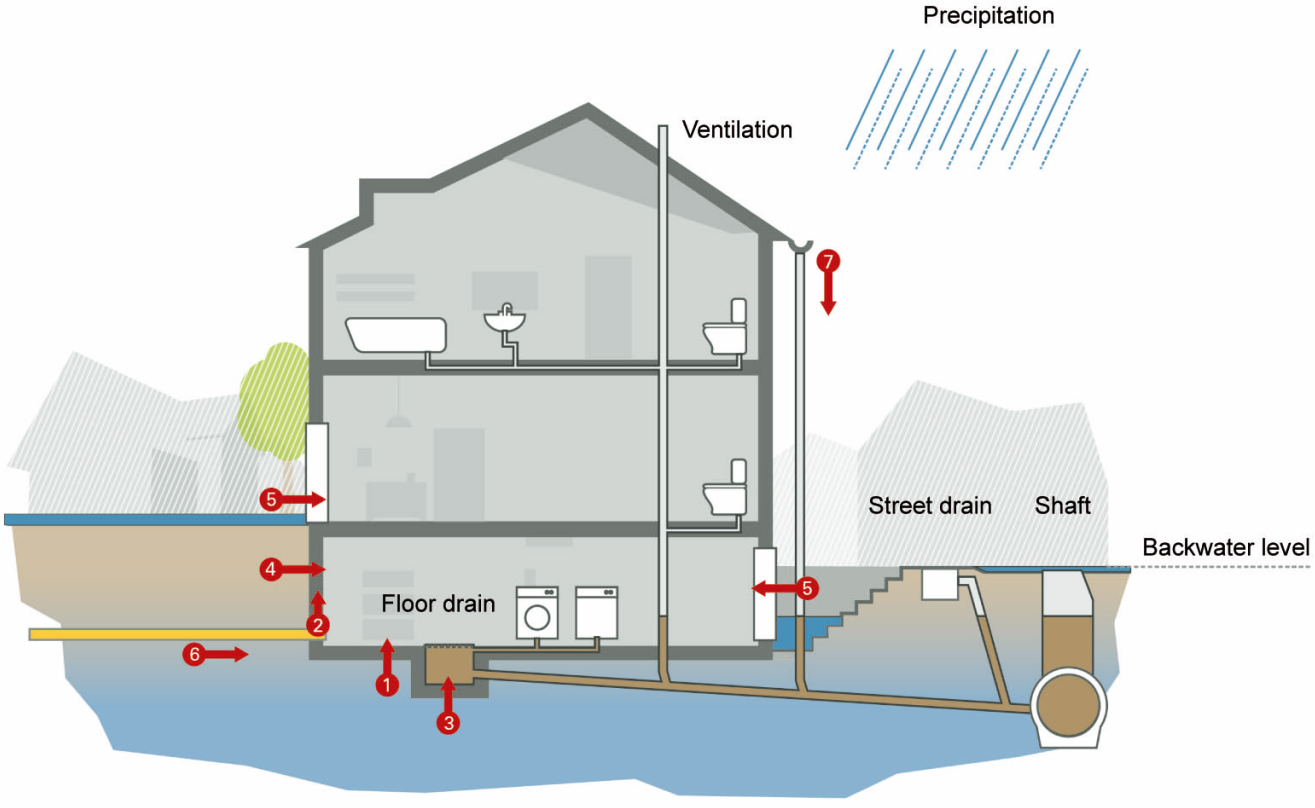

Figure 5
Water ingress possibilities due to heavy rainfall (Reinhard Beck engineering office)

PROTECTION AGAINST BACKWATER FROM THE SEWER NETWORK

During heavy rainfall, most flooding damage in buildings is caused by missing, incorrectly installed or defective backflow prevention devices!

During heavy rainfall, the sewer quickly fills up with a lot of water, which quickly reaches the permitted upper limit - the so-called backwater level. The backflow level is the highest level to which water can rise in a drainage system according to regulations (DIN EN 12056, 2000). In principle, there is no danger from a filled sewer. However, water strives to reach the same level everywhere. Therefore, if house connections in the building are below the backflow level of the public drainage system, backflow prevention devices are required. They prevent the water from being forced into the house. If there are no backflow protection devices, neither the insurance company nor the ocal authority will pay in the event of damage.

The choice of a suitable backflow preventer, regardless of whether it is a backwater valve or lifting unit, depends on the type of wastewater. A distinction is made between faecal-free (grey water) and faecal-rich (black water) wastewater (Hamburg Wasser, 2012; hanseWasser, 2017).

Backwater level

The height of the backwater level is specified in the drainage bylaws of the municipalities. Normally, this is at the level of the nearest shaft or kerb.

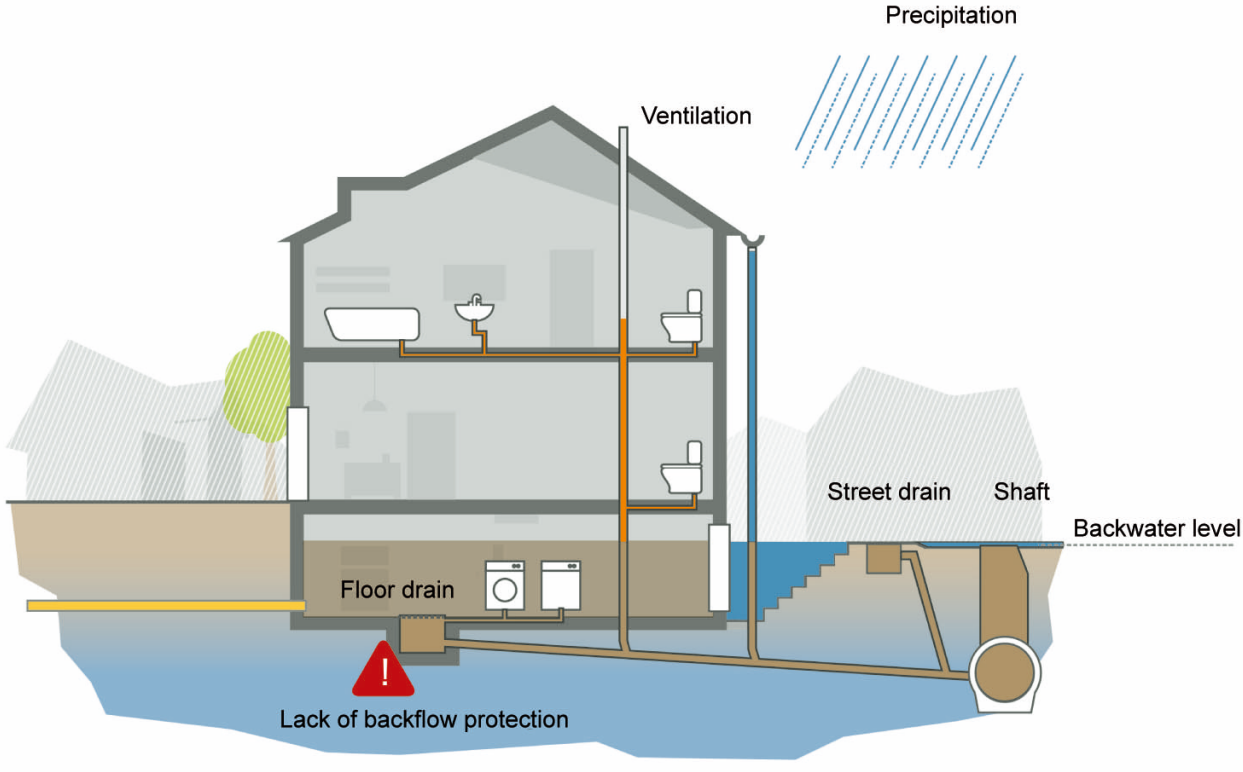

Figure 6
Flooding due to backwater from the sewer (Ingenieurbüro Reinhard Beck)

SEWAGE LIFTING UNIT

Lifting systems protect against backwater by pumping the domestic wastewater via a so-called backflow loop above the level of the backwater level. From there, it drains freely into the public network. This is also possible if water is already backing up in the sewer. The principle of communicating pipes is interrupted by the height of the backflow loop. Lifting systems offer the greatest possible protection. Because they enable the permanent drainage of domestic wastewater, they are even mandatory - unless the rooms concerned are only used to a lesser extent (hanseWasser, 2017).

Wastewater lifting units should be maintained twice a year for apartment buildings and once a year for single-family homes (DIN EN 12056-4, 2001).

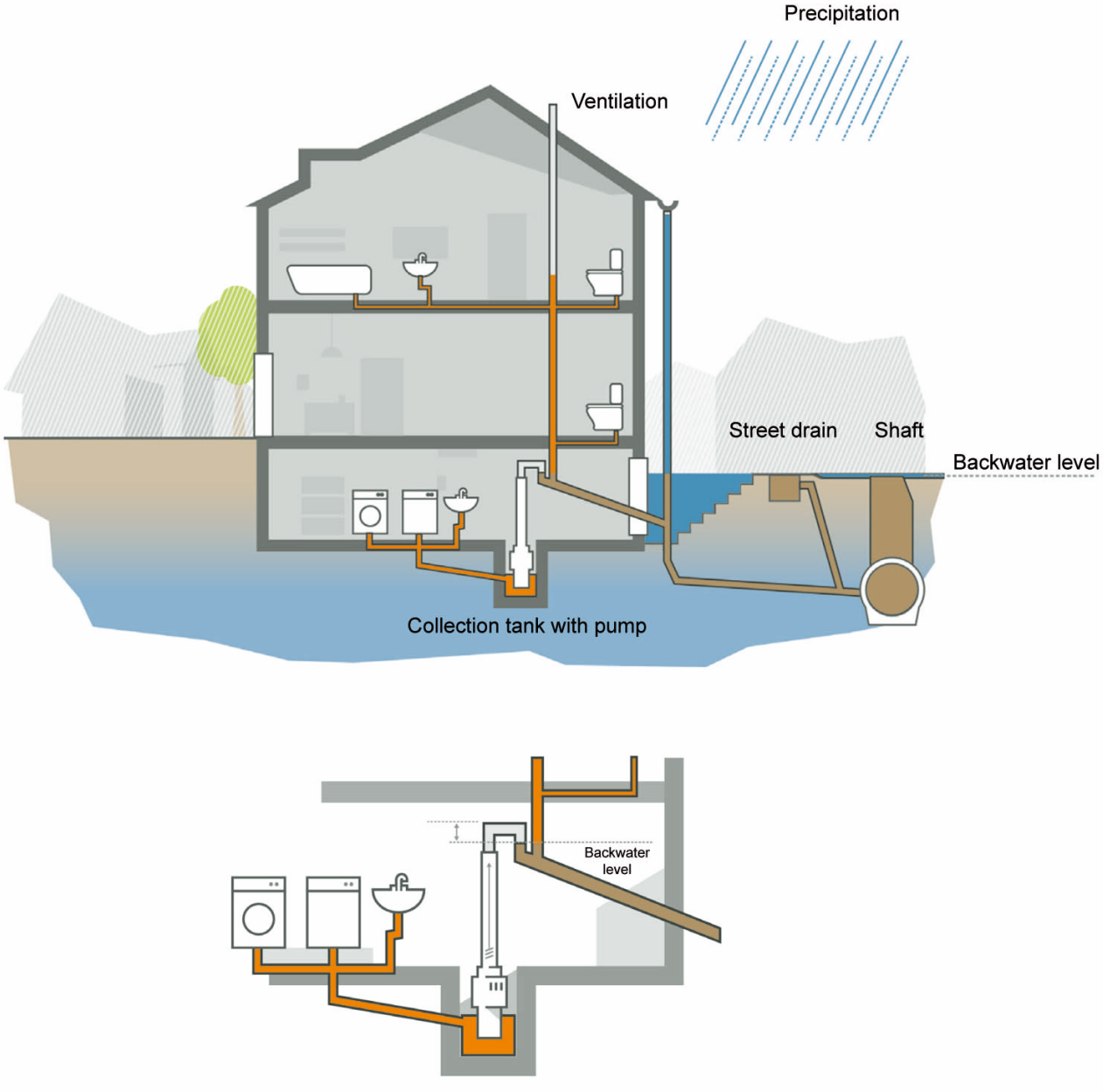

Figure 7
Function of a wastewater lifting station (Ingenieurbüro Reinhard Beck)

BACKWATER VALVE

Backwater valves use flaps to prevent water from the public drainage system from flowing into the building. Depending on the wastewater and local conditions, there are different types, all of which are designed as automatic double flaps: The first flap closes automatically in the event of back-flowing wastewater, while the second is an emergency closure that can be operated manually (Hamburg Wasser, 2012; HKC, 2017).

As the wastewater cannot be discharged in the event of a backflow, backwater valves may only be used if the following conditions are met (otherwise a sewage lifting unit must be used):

- There is a gradient to the sewer,
- The protected rooms are of secondary use (there are no significant material assets and the health of the occupants is not impaired if the rooms are flooded),
- The user group is small and a WC is available above the backflow level,
- In the event of backwater, the drainage point can be dispensed with (DIN EN 12056-4, 2000).

Backwater valves should generally be maintained twice a year by an expert (DIN EN 13564-1, 2002).

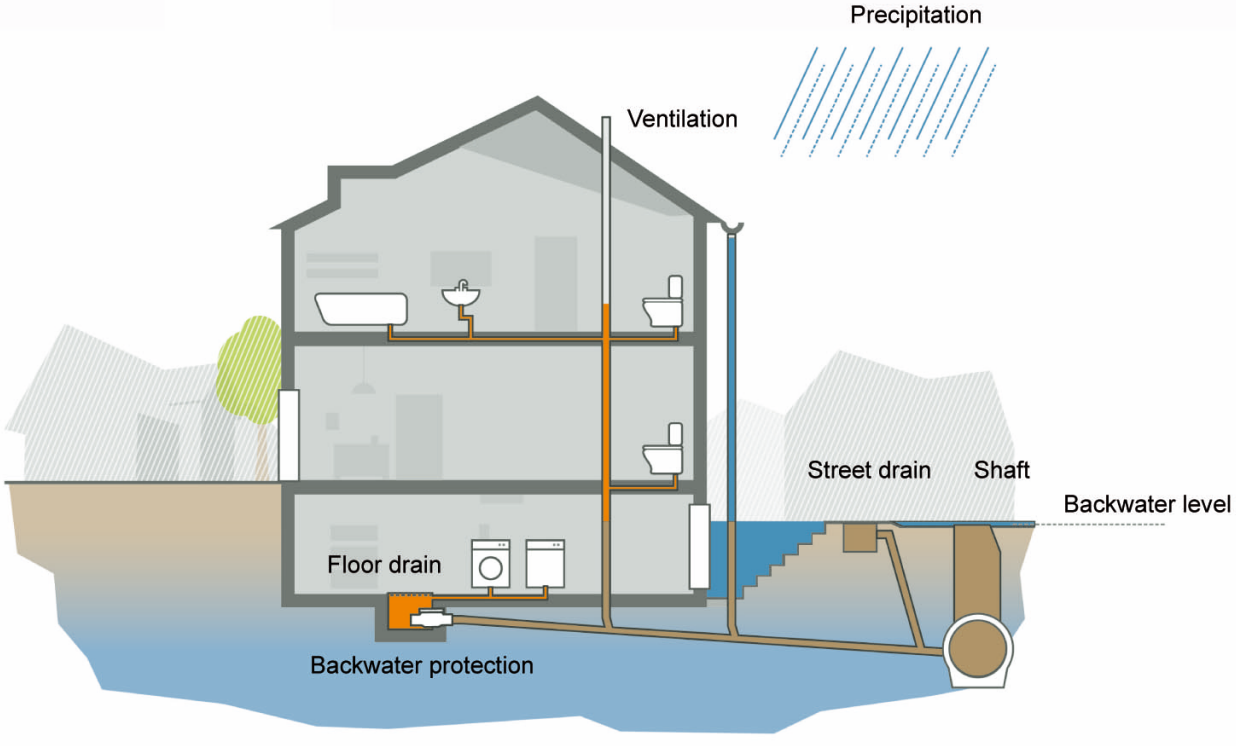

Figure 8
Function of a backwater valve (Ingenieurbüro Reinhard Beck)

Source: Federal Institute for Research on Building, Urban Affairs and Regional Planning at the Federal Office for Building and Regional Planning